UNION SWITCH & SIGNAL

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PN-150SST
Solid State Timer
(Part Numbers N40107201, N40107202, and N40107203)

- ♦ Installation
- ♦ Operation

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Revision History

Rev.	Date	Nature of Revision
Original	February 2004	Original Issue

Table of Contents

Section 1. Introduction 1-1

1.1. Background 1-1
1.2. General Description 1-1
1.3. Application 1-1
1.4. PN-150SST Specifications 1-2
1.5. Controls, Indications, and Identification 1-3
1.5.1. Toggle Switches 1-3
1.5.2. LED Display 1-3
1.5.3. Identification 1-3
1.6. Input Power 1-3
1.7. Output Power 1-3
1.8. Safety 1-4

Section 2. Equipment Description 2-1
2.1. PN-150SST Solid State Timer 2-1

Section 3. Installation 3-1
3.1. PN-150SST Preparation 3-1
3.2. Timer Indexing 3-1
3.3. Receptacle Contact Springs 3-3
3.4. Crimping Wires into Receptacle Contact Springs 3-3
3.5. Programming the Delay Time 3-4
3.5.1. Adjustment Ranges 3-4
3.5.2. Toggle Switch Functions (Figure 3-2) 3-4
3.5.3. Programming Sequence - Short Range 3-5
3.5.4. Programming Sequence – Long Range 3-6
3.6. Field Testing the Delay Time 3-7
3.7. Programming the Slow Drop Away Time 3-8
3.7.1. Programming Sequence - Short Range 3-8
3.7.2. Programming Sequence - Long Range 3-9
3.8. Field Testing the Drop-Away Delay Time 3-10

Section 4. Troubleshooting 4-1
4.1. Error Codes 4-1
4.2. Frequently Asked Questions by Topic 4-3

Section 5. Maintenance 5-1

Section 6. Technical Support 6-1

List of Figures

Figure 2-1 - PN-150SST Solid State Timer....2-1
Figure 3-1 - PN-150SST Rear View....3-2
Figure 3-2 - Toggle Switch Functions....3-4

List of Tables

Table 1-1 - PN-150SST Assemblies and Mounting Base....1-2
Table 1-2 - PN-150SST Operating Characteristics....1-2
Table 2-1 - Timing Information....2-1
Table 3-1 - Indexing Pin Locations....3-2
Table 3-2 - Crimping Tools for Wire Installation....3-3
Table 3-3 - Short Range Programming Sequence....3-5
Table 3-4 - Long Range Programming Sequence....3-6
Table 3-5 - Testing the PN-150SST Time Delay Setting....3-7
Table 3-6 - Programming Sequence - Short Range....3-8
Table 3-7 - Programming Sequence - Long Range....3-9
Table 4-1 - Troubleshooting Table....4-1
Table 4-2 - Error Codes....4-2
Table 4-3 - Frequently Asked Questions....4-3

Section 1. Introduction

1.1. Background

Union Switch & Signal originally developed the PN-150EVT electronic vital timer relay to serve as a solid-state replacement for thermal and mechanical timer relays. The PN-150EVT's electronic module and contacts, which are in a three-front/one-back arrangement, are fitted into a standard US&S PN-150-style relay frame. To offer a solid-state timer that can drive an external relay with more contacts, which is suitable for a wider variety of applications, US&S developed the PN-150SST Solid-State Timer.

1.2. General Description

The US&S PN-150SST Solid-State Timer consists of an electronic module mounted in a standard US&S PN-150 relay frame. The timer's electronic module is the same as the one used in the PN-150EVT unit and includes a digital display. Because it's designed to drive an external vital relay, the PN-150SST contains no relay contacts.

1.3. Application

CAUTION

The PN-50SST provides a positive (10B) and negative (11C) output to drive a repeater relay coil after the preset time has expired. This power must not be connected to any other energy source.

The PN-150SST Solid-State Timer is available in three versions:

- The PN-150SST/SP offers programmable slow-pick-up capability.
- The PN-150SST/DPSD is a programmable slow drop away timer with a five-second pick-up delay. This unit is intended to serve as a loss-of-shunt timer in conjunction with a delayed code change or a delayed initiation of grade crossing signals.
- The PN-150SST/SD features a programmable slow drop away capability. The pick-up is also nominally delayed by approximately 0.3 seconds to guard against unwanted pick-up from a momentary input.

A US&S PN-150 relay (240 to 400 ohms) is typically driven by the PN-150SST timer. The output energy of the PN-150SST is approximately 68% of the input energy.

Table 1-1 provides ordering references.

Table 1-1 - PN-150SST Assemblies and Mounting Base

US&S Part Number	Description
N40107203	PN-150SST/SD, slow drop timer
N40107202	PN-150SST/DPSD, delayed pick, slow drop timer
N40107201	PN-150SST/SP slow pick timer
N4513760302	Mounting base with hardware (14-16 contacts)
N4513760601	Alstom/Safe compatible mounting base with hardware (14 - 16 contacts)

1.4. PN-150SST Specifications

Table 1-2 presents the operating characteristics of the PN-150SST.

Table 1-2 - PN-150SST Operating Characteristics

Parameter	Value
Dimensions	H = 8¼", W = 3¼", D = 9 7/64"
Operating Voltage	Control: 9.2 - 30 Vdc filtered or 9.2 - 24 Vdc ± 0.2 V unfiltered full wave rectified DC from a 25 Hz or greater AC source Local: 9.2 - 30 Vdc (source may be steady or coded at a minimum 75 ppm with at least a 35% on-time) Both inputs protected against reverse polarity
Current draw	Maximum continuous current is 125 mA with a 600 mA surge current on startup
Indexing	4-0-7-2 for N40107201 4-0-7-3 for N40107202 4-0-7-4 for N40107203
Operating Temperature	-40° to 158° F (-40° to 70° C)
Humidity	0-95% relative humidity, non-condensing
Timing Range	Short Range: 0 to 59.9 seconds, 0.1-second increments Long Range: 0 to 52 minutes (0-3120 seconds), 1-second increments
Accuracy	±0.3 seconds with Vin >10 Vdc Below 10 Vdc time may run long by an additional 0.1 seconds Better than 0.1% under all conditions at any time setting (external relay mechanism pick-up delays approximately 250-300 mS). Add two seconds to timing interval for initialization delay if local is energized simultaneously with commencement of timing cycle
Dielectric Strength	2 kv between control and local input circuitry 2 kv between input circuitry and frame

1.5. Controls, Indications, and Identification

1.5.1. Toggle Switches

Two toggle switches located on the face of the timer allow the user to program the timing interval in the shop or field without disassembling the relay, breaking the mechanism seal, or disturbing internal adjustments. An independent, sealable cover encloses the toggle switches. This cover may be sealed using a relay seal to prevent tampering with the time settings. Refer to Section 3.5 for instructions on programming the time delay.

1.5.2. LED Display

The PN-150SST is provided with a large, easy-to-read, four character alphanumeric LED display located on the face of the timer. In operation, the display serves to indicate the status of the timer: deenergized, running, or energized. While programming the timing interval, the display prompts the user's actions and indicates the preset timing interval. The LED display will also indicate error codes when hardware or logic faults are detected.

1.5.3. Identification

Each US&S plug-in relay is provided with a nameplate indicating the type of device, part number, and serial number. The serial and part numbers are engraved on this nameplate. An inspection sticker secured to the inside of the cover shows the specific operating values and serial number of the device.

1.6. Input Power

The nominal range of DC input power for the PN-150SST is 9.2 - 30 Vdc, corresponding to a battery composed of 5 to14 lead-acid cells or 8 to 22 nickel-alkaline cells.

The PN-150SST has two inputs: control (9B+, 12B-) and local (7B+, 8B-). Local energy is used for various support purposes, including operation of the microprocessor, the LED display, and associated circuitry. Control energy initiates the timing cycle and provides power to a conditional power supply and relay driver which directly drives the relay coil, thus the control input current will be somewhat higher and varied compared to the local input. Both inputs require dc energy within the range of 9.2 to 30 Vdc (9.2 to 24 Vdc unfiltered full wave). The combined local and control load is less than one watt while the relay coil is energized at 9 to 12 Vdc.

Voltages less than 9.2 Vdc at the control input will temporarily halt operation. Circuitry is protected against damage from sustained voltage exceeding 33 volts by means of Polyswitches®. A Polyswitch® acts much like a fuse but, unlike a fuse, it will reset to a low resistance state when the input voltage is restored to the normal operating range. Local and control inputs are protected against polarity reversal.

1.7. Output Power

The PN-150SST output can operate a 200 to 400 ohm coil. The voltage output is approximately 68% of the input voltage.

1.8. Safety

The design of the hardware and software within this timer is such that any failure or combination of failures will cause the relay to open or remain open. Fail-safe design principles assure that under no circumstances will there be a voltage output less than the time delay following application of energy to the control input.

Section 2. Equipment Description

2.1. PN-150SST Solid State Timer

The PN-150SST/SP (slow pick-up), the PN-150SST/DPSD (delayed pick-up/slow drop away), and the PN-150SST/SD (slow drop away) are vital timer units (Figure 2-1). These units are similar to the N401017xx and N401033xx series Timer Relays except the electromechanical relay has been removed from the package to provide flexibility to drive an external relay with more contacts. The microprocessor-based printed circuit board mounted within the enclosure provides the identical timing function, either slow pick-up, delay pick-up/slow drop away, or slow drop away to the external relay. The package design is based on the standard PN-150 relay package. Timing information is provided in Table 2-1.

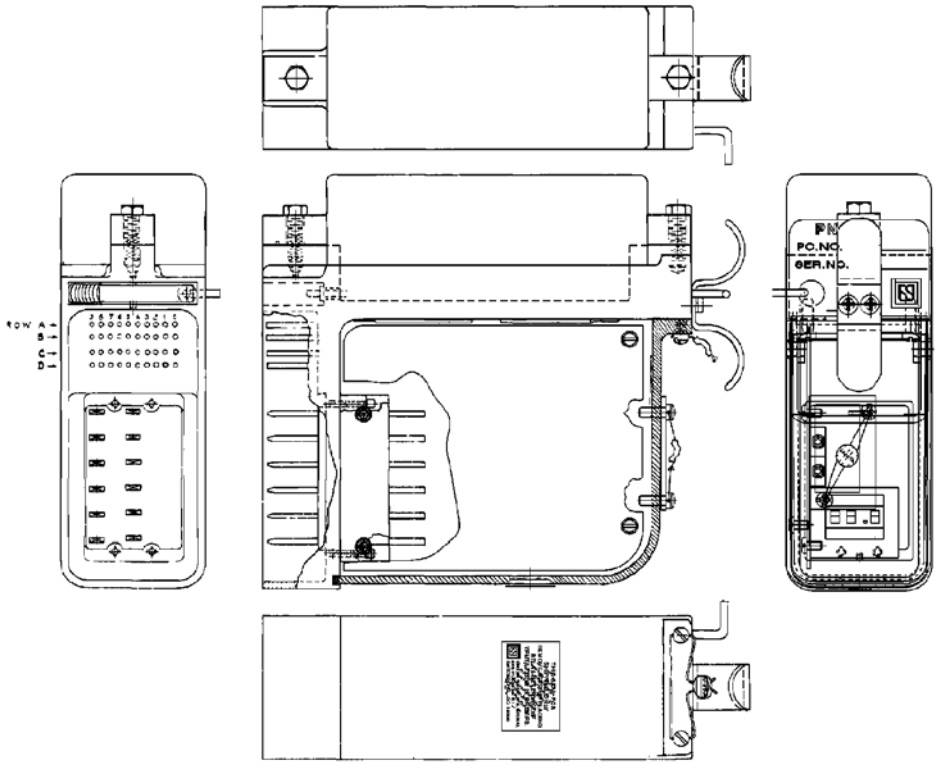


Figure 2-1 - PN-150SST Solid State Timer

Table 2-1 - Timing Information

Parameter	Value
Time Delay	0.1 sec to 52 minutes or 1 sec to 52 minutes
Slow Pick Timer	The Slow Pick timer provides an output to pick-up the external relay after the microprocessor detects the presence of the control input and processes the time delay as set in the unit. The output is removed when the control input is removed.

Parameter	Value
Slow Drop Timer	The Slow Drop timer removes the output voltage to the external relay only after the microprocessor detects the absence of the control input and completes the time delay as set in the unit. The output is reapplied to the external relay when the control input is reapplied.
Delayed Pick/Slow Drop timer	The Delayed Pick/Slow Drop timer provides both a delayed pick-up, with the output applied 5 seconds after the microprocessor detects the presence of the control input. It also features slow drop-away, with the output removed only after the microprocessor detects the absence of the control input and completes the time delay as set in the unit.

Section 3. Installation

3.1. PN-150SST Preparation

Perform the following steps to prepare the PN-150SST for use:

1. Attach the mounting base to the rack using the hardware provided with the optional base.

2. Wire the timer to specific application circuits. (Refer to Figure 3-1 for index pin locations and Section 3.4 for wiring and crimping information.)

3. Insert the timer into the mounting base.

4. The relay is now ready to apply power and program.

3.2. Timer Indexing

This relay is equipped with indexing pins to prevent insertion of incorrect equipment into a mounting base. Each timer has an indexing plate which is applied to the mounting base at the time of initial installation.

The following data defines the indexing that has been established for timers covered by this manual.

a. The index code always consists of four figures (such as 0001, 0002, or 0101) and is used for both the timer and the indexing plate on the mounting base.

b. The index code for each mounting base is determined by the placement of the holes in the numbered vertical rows of the large white nylon indexing plate which is affixed to the front of the mounting base (Table 3-1). Never remove the indexing plate from the mounting base unless it is damaged or the indexing is to be purposely changed to accommodate a different part number. Discard the indexing plate unless it is needed for replacement of a damaged indexing plate or for application to a new mounting base.

WARNING

Never drill new holes in a base indexing plate which will permit application of relays with different part number or change indexing pins on the back of a relay unless it is being converted to a new part number. Drilling new holes in the base indexing plate will compromise the safe functioning of the circuit.

Table 3-1 - Indexing Pin Locations

Relay Part No.	Row			
	A	B	C	D
N40107201	4	0	7	2
N40107202	4	0	7	3
N40107203	4	0	7	4

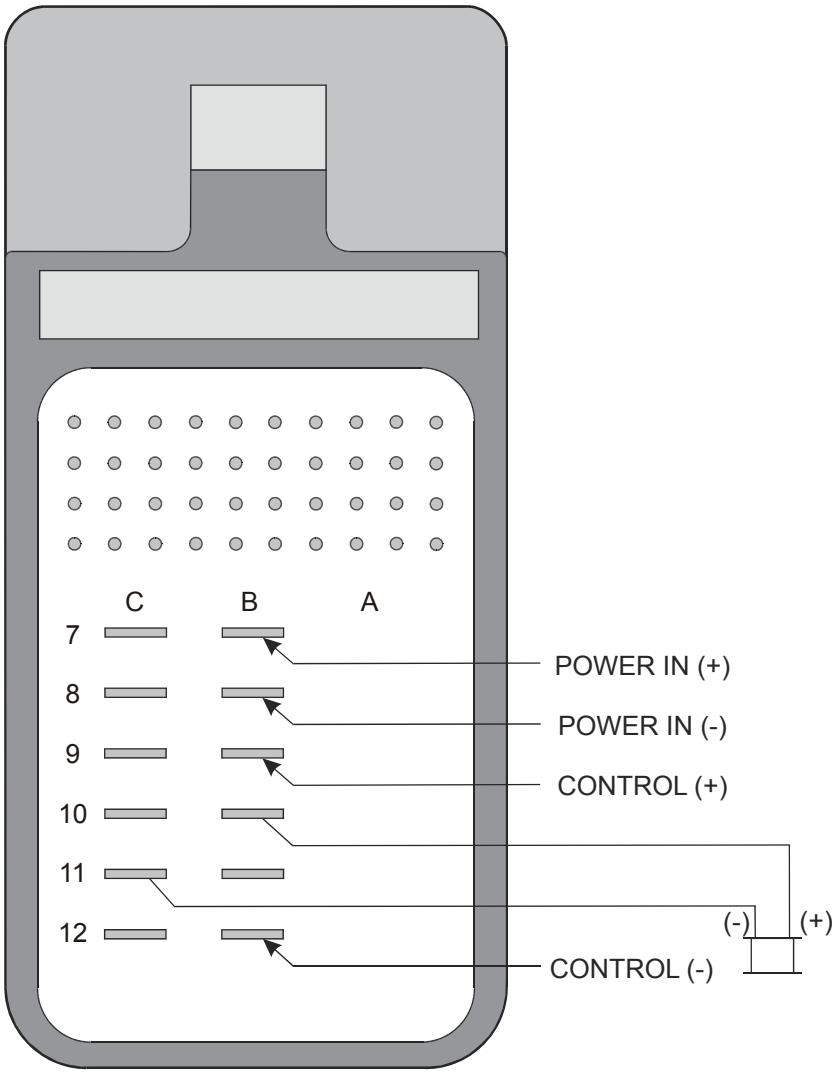


Figure 3-1 - PN-150SST Rear View

3.3. Receptacle Contact Springs

The one-piece mounting base with hardware (N4513760302 and N4513760601) includes a full complement of receptacle contact springs (M451142-2702) to accommodate one or two #14 - #16 wires, mounting fasteners, and tags. It can also be equipped with receptacle contact springs for one or two #10 - #12 wires (M451142-2703), or for one or two #18 - #20 wires (M451142-2701). Make certain which type of solderless receptacle contact springs accompany the mounting base before proceeding with their installation. Inspect each solderless receptacle contact spring before proceeding with installation.

The following is recommended when installing solderless receptacle contact springs:

a. Receptacle contact springs must be inserted into the base with the lanced tab up.

b. Make certain that the lanced tab is slightly compressed as the receptacle contact spring is inserted along the top of the cavity. The lanced tab could have been bent during handling, and therefore might not provide the required contact pressure after the relay is inserted. If the lanced tab does not touch, slightly compress using fingers or suitable tool.

c. After insertion, pull firmly on the wire to make certain the receptacle contact spring is locked in the mounting base.

3.4. Crimping Wires into Receptacle Contact Springs

Use the following procedure to ensure a good electrical and mechanical connection between the conductor wire and the receptacle contact spring. Table 3-2 identifies the correct crimping tool to be used when installing wires in receptacle contact springs.

Table 3-2 - Crimping Tools for Wire Installation

Crimping Tool	Wire Size	Receptacle Contact Spring
J397138	#10/#12 AWG	M451142-2703
J397139	#14/#16 AWG	M451142-2702
J397188	#18/#20 AWG	M451142-2701

1. Strip 3/16 in. (0.187 in. or 0.47 cm.) of insulation from the end of the wire.

2. Place the receptacle contact spring into the jaws of the proper crimping tool. When using only one wire, use the shortest barrel.

3. Partially close the crimping tool jaws against the receptacle contact spring to hold it in place. (Do not crush the receptacle contact spring barrel at this time.)

4. Insert the stripped end of the wire completely into the receptacle contact spring barrel. Squeeze the tool handles until crimping is completed and the jaws release. When using both barrels, it is more convenient to attach the first wire to the longest barrel.

5. Remove the crimped receptacle contact spring from the tool and inspect the connection. Make certain that the wire is flush with the crimped barrel and that there are no loose strands of wire.

3.5. Programming the Delay Time

The timer's delay time is adjusted by using the two toggle switches located under the transparent cover on the face of the timer. Remove the two screws holding the transparent cover in place to access the switches. Note: The screw heads are drilled so that they can be wired together and sealed to secure the settings after the adjustment is made.

3.5.1. Adjustment Ranges

There are two adjustment ranges:

Short Range 00.0 seconds - 59.9 seconds, adjustable in 0.1-second increments. and

Long Range 0 seconds – 52 minutes (0 - 3120 sec.), adjustable in 1-second increments.

3.5.2. Toggle Switch Functions (Figure 3-2)

The upper toggle switch (SW1) is normally used to increase or decrease values on the LED display. When SW1 is pushed upwards, it will increase the current value. When SW1 is pushed down it will decrease the current value.

The lower toggle switch (SW2) serves the **"ENTER"** and **"ESCAPE"** functions. When SW2 is pushed upwards, it activates the ESCAPE function. When SW2 is pushed down, it activates the ENTER function.

Sections 3.5.3 and 3.5.4 explain the time delay programming sequence for the short and long time delay ranges.

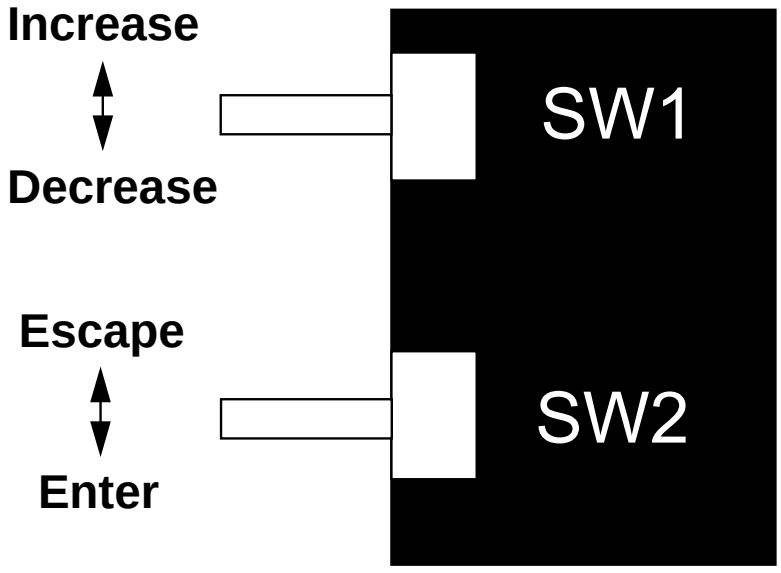
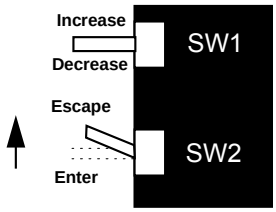
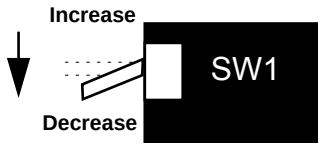
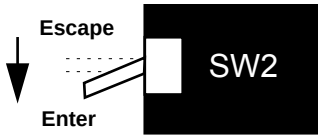


Figure 3-2 - Toggle Switch Functions

3.5.3. Programming Sequence - Short Range

Table 3-3 lists the steps necessary to program the PN150SST in its short range.

Table 3-3 - Short Range Programming Sequence

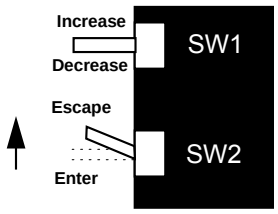
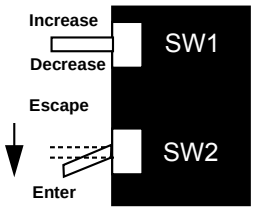
Setup	Action	Result / LED Display
1. Apply 9.2 to 30 Vdc to local terminals (7B+, 8B-). Remove energy from control input (9B+, 12B-) if present.		SLO ↑ ◄► 10.2 **ALTERNATING DISPLAY**
2. Press ESCAPE to enter programming mode. 		< 60
	Press INCREASE or DECREASE to select short timing range (00.0 sec. to 59.9 sec.).  Press ENTER to accept setting 	< 60
3.	Press INCREASE or DECREASE to change value of flashing digit (range of tens digit is 0-5). Press ENTER to accept timing.	Underlined digit represent a flashing digit. 10.2
4.	Same as above for next digit.	10.2

Setup	Action	Result / LED Display
5.	Same as above for next digit.	10.2
6.	Wait 2 seconds.	10.2
7. Unit is ready for operation.		SLO ↑ ◄► 10.2 ALTERNATING DISPLAY
8. Field test of timing interval must be performed before placing unit in service. (See Section. 3.6).		

3.5.4. Programming Sequence – Long Range

Table 3-4 lists the steps necessary to program the PN150SST in its long range.

Table 3-4 - Long Range Programming Sequence

Setup	Action	Result / LED Display
1. Apply 9.2 to 30 Vdc to local terminals (7B+, 8B-). Remove energy from control input (9B+, 12B-) if present.		SLO ↑ ◄► 0621 ALTERNATING DISPLAY
2. Press ESCAPE to enter programming mode. 	Press ENTER to accept long timing range (0000--3599). 	> 60
3.	Press INCREASE or DECREASE to change value of flashing digit (range of minutes tens digits is 0-5). Press ENTER to accept setting.	Underlined digit represents a flashing digit. 06 M
4.	Same as above for next digit.	06 M
5.	Same as above for next digit.	21 S

Setup	Action	Result / LED Display
6.	Same as above for next digit.	21 S
7.	Wait 2 seconds.	0621
8. Unit is ready for operation.		SLO ↑ ◆ 0621 ALTERNATING DISPLAY
9. Field test of timing interval must be performed before placing unit in service. (See Section 3.6).		

3.6. Field Testing the Delay Time

The delay time must be must be field-tested whenever a PN-150SST is installed or replaced with a new PN-150SST. The purpose of the check is:

1. To ensure the user has correctly programmed the specified time interval,
2. That identical PN-150SSTs with different time delays have not been accidentally exchanged or misidentified, and
3. To verify that the wiring between the PN-150SST and the repeater is correct.

The example in Table 3-5 shows how to reliably field-test the PN-150SST's time delay setting.

Table 3-5 - Testing the PN-150SST Time Delay Setting

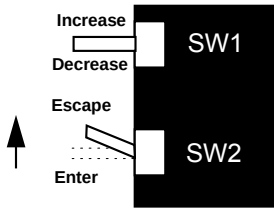
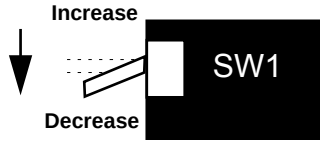
Setup	Action	Result / LED Display
1. Apply 9.2 to 30 Vdc to local terminals (7B+, 8B-).	Check idle display indication for normal alternating action. Verify that time interval agrees with value shown on circuit plans or as otherwise directed.	SLO ↑ ◆ 0621 ALTERNATING DISPLAY
2.	Apply 9.2 to 30 Vdc to control input (9B+, 12B-) and simultaneously start stopwatch. Observe countdown indication on display.	START FINISH 0621 → 0000 COUNTDOWN

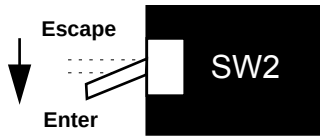
Setup	Action	Result / LED Display
3.	Halt stopwatch when display indicates timer is energized. Use a voltmeter to check the output voltage on contacts 10B (+) and 11C (-) on the rear of the relay. The measured output voltage should be 68% of the input voltage.	PCKD
4.	Remove energy from control input (9B+, 12B-). The voltage on 10B(+) and 11C(-) should be 0 volts.	SLO ↑ ◄► 0621 **ALTERNATING DISPLAY**

3.7. Programming the Slow Drop Away Time

3.7.1. Programming Sequence - Short Range

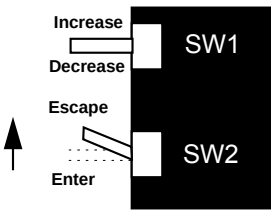
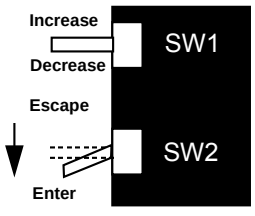
Table 3-6 - Programming Sequence - Short Range

Setup	Action	Result / LED Display
1. Apply 9.2 to 30VDC to local terminals (7B+, 8B-). Remove energy from control input (9B+, 12B-) if present.	If energy is not present on the control input, display will read: DRPD	SLO ↓ ◄► 10.2 **ALTERNATING DISPLAY**
2. Press ESCAPE to enter programming mode. 		> 60
	To accept > 60 sec., press enter (SW2 down). Otherwise, toggle SW1 up or down. The display will then indicate < indicating less than 60 seconds.  Press ENTER to accept setting	< 60

Setup	Action	Result / LED Display
		
3.	Press INCREASE or DECREASE to change value of flashing digit (range of tens digit is 0-5). Press ENTER to accept timing.	Underlined digit represent a flashing digit. 10.2
4.	Same as above for next digit.	10.2
5.	Same as above for next digit. When ENTER is last activated the time delay is set.	10.2
6.	Wait two seconds.	10.2
7. Unit is ready for operation.		DRPD
8. Field test unit before placing in service.	See Section 3.8.	

3.7.2. Programming Sequence - Long Range

Table 3-7 - Programming Sequence - Long Range

Setup	Action	Result / LED Display
1. Apply 9.2 to 30VDC to local terminals (7B+, 8B-). Remove energy from control input (9B+, 12B-) if present.	If energy is not present on the control input, display will read: DRPD	SLO ↓ ◄► 0621 **ALTERNATING DISPLAY**
2. Press ESCAPE to enter programming mode. 	Press ENTER to accept high timing range (0000--3120) 	> 60
3.	Press INCREASE or DECREASE to change value of flashing digit (range of	Underlined digit represent a flashing digit.

Setup	Action	Result / LED Display
	minutes tens digits is 0-5) Press ENTER to accept setting.	06 M
4.	Same as above for next digit.	06 M
5.	Same as above for next digit.	21 S
6.	Same as above for next digit. When ENTER is last activated the time delay is set.	21 S
7.	Wait two seconds.	0621
8. Unit is ready for operation		DRPD
9. Field test unit before placing in service	See Section 3.8.	

3.8. Field Testing the Drop-Away Delay Time

The delay time must be field tested whenever a PN-150SST slow drop away version relay is installed or replaced with a new relay. The purposes of the check are:

To ensure the user has correctly programmed the specified time interval.

To ensure that identical relays with different time delays have not been accidentally exchanged or misidentified.

Section 4. Troubleshooting

In the case of a malfunctioning PN-150SST, use Table 4-1 to help identify possible causes of the problem.

Table 4-1 - Troubleshooting Table

Symptom	Possible Cause
1. Absence of the LED display.	This may indicate a loss of local energy or failure of the internal electronics. Return unit to US&S for evaluation and repair.
2. Repetitive error codes followed by shutdown of timer. (See Section 4.1 for a description of error codes).	This may indicate problems with the timer's logic or hardware faults. Return unit to US&S for evaluation and repair.
3. Timing cycle does not initiate when control energy is applied.	This may indicate one of the following: 1. The desired time delay has not been correctly programmed. 2. Possible failure of internal electronics. 3. Control voltage intermittent or below 9 Vdc.
4. Time delay not in accordance with desired value.	Problem most likely due to errors in programming of the time delay.
5. Failure of the timer to pick-up upon completion of the timing cycle.	Check the output voltages on 10B(+) and 11C(-) Check the calibration values on the repeater and replace if out of specification. It the checks were acceptable, return the unit to US&S for evaluation and repair.
6. The ESCAPE switch is actuated but unit does not display ">60" prompt.	Check to confirm absence of control energy. Momentarily remove the unit from the base to force re-initialization of the system. Replace unit if problem persists. Return unit to US&S for evaluation and repair.

In many instances, the source of trouble may be found by close examination of the timer, its base, and associated wiring. To prevent unnecessary delay and expense of "No Trouble Found" returns to the shop or US&S, a brief explanation of specific conditions and type of trouble encountered should accompany each defective timer. Such information is especially important in cases of intermittent trouble or where display of error codes has been observed.

The sealed mechanism cover must not be opened except by qualified personnel in a shop equipped to properly calibrate and test timers. All defective PCBs should be returned to US&S for evaluation and repair. Timers exposed to moisture, electrical surges or mishandling must be returned to the shop or US&S for refurbishment and retest.

4.1. Error Codes

Error codes appear on the LED display when logic or hardware faults are detected. All faults cause immediate termination of the timing cycle. If the timing cycle is complete, faults will cause immediate drop-away of the timer. The system will reset two seconds after the fault is detected. If nine

consecutive faults occur without successful operation for at least one second, then the system will become dormant, stopping timing operation and maintaining display of the latest error code until local power is momentarily cycled off and on. Table 4-2 presents a list of possible error codes.

Table 4-2 - Error Codes

Error	Display	Reason
INSTRUCTION_ERROR	INSTR	Generic HC11 instruction failure
RAM_ERROR	RAM	RAM write/read failure
RAM_1S_ERROR	RAM1	RAM walking 1's failure
DIAG_ERROR	DIAG	Generic diagnostic failure
CONFIG_ERROR	DIAG	HC11 configuration register failure
GLITCH_ERROR	GLIT	Generic double compare failure
RUN_AWAY_ERROR	AWAY	Unused interrupt failure
EXEC_ERROR	EXEC	Generic executive failure
CHECKSUM_ERROR	CHKS	EPROM checksum failure
BCH_ERROR	BCH	EPROM BCH failure
RESET_ERROR	REST	Generic reset failure
ILLEGAL_IRQ	IRQB	Invalid interrupt failure
BAD_STACK	STKB	Stack out-of-range failure
BAD_RETURN	RETB	Bad return address from interrupt failure
BAD_DIAGS	DIAG	Diagnostic failure
MODE_ERROR	MODE	Generic menu mode error
COP_ERROR	ECOP	COP monitor reset
NO_CLOCK_ERROR	NCLK	No clock monitor reset
EEPROM_ERROR	EPRM	Generic EEPROM filure
BAD_DIVIDE	BDIV	Bad divide or divide by 0 failure
ERASED_EEPROM_WAIT	WAIT	EEPROM erased and awaiting power to be recycled
T1_ERROR	T1ER	Invalid internal interrupt counter
UNSTABLE_INPUT	UNST	Input circuit may be failed or input signal is intermittent
BAD_INPUT_ERROR	IBAD	Input circuit failure, HC11 pins 20, 21, and 50
OUTPUT_ERROR	0BAD	Mismatch of HC11 pins 14 and 22
T2_ERROR	T2ER	Second time source failure, HC11 pins 32 and 33
PULSE_ERROR	PULS	Pulse accumulator error, HC11 pin 27

4.2. Frequently Asked Questions by Topic

Table 4-3 presents a list of frequently asked questions by topic.

Table 4-3 - Frequently Asked Questions

Topic	Question	Answer
Programming Switches	What if the programming switches are manipulated during timing cycle or while relay is energized?	Programming switch activity is ignored while the control input is energized. The timing cycle will not be interrupted if programming switches are manipulated while control energy is applied.
	What if a programming switch is stuck in a position other than center?	Stuck programming switches will be ignored or unit will shutdown while display shows the ">60" prompt.
	What if both programming switches are simultaneously actuated?	This won't cause any harm to the timer but may result in undesired results.
Time Setting	What if the time delay is set to 0000?	Timer will pick-up with zero time delay (pick-up delay of the timer mechanism is roughly 200-400mS, depending on factors such as control voltage, temperature and calibration variables).
	Can time setting be set to wrong setting for a specific application? What prevents improper exchange of PN-150SSTs with different time settings?	No general purpose time element can protect against such errors. The user must program and test the time interval whenever a PN-150SST is installed or replaced. Proper timing is assured only after the unit is tested while plugged-in and connected to the actual controlling circuit. Note that FRA rules 49 CFR 236.109 and 234.265 require the proper time setting to be shown on the circuit plans or the relay.
	Could a fifth index pin be added to provide indexing protection for timers having different time intervals?	No. Addition of extra holes in the index plate could allow improper installation of timers having only four pins.
Testing	Should time delay be checked with some type of calibrated timing device or chart recorder?	Timing may be checked with a stopwatch or wristwatch. Assuming a timing error of +/- 10% is allowable, the worst-case combined error of the PN-150SST and an ordinary wristwatch would still be well within the 10% limit at the maximum interval of 3120 seconds (an error of 6 minutes per hour). Specialized time measuring devices are needed only where 0.1 second timing increment is significant or for the user's convenience in making long interval measurements.

Topic	Question	Answer
Display	What if individual LED or row/column of LEDs in display is not as bright as usual?	Ignore unless digit(s) cannot be easily distinguished.
	What if display is intermittent, dim, or unrecognizable or otherwise incorrect.	Check the list of status and error codes. Momentarily remove the unit from base to force re-initialization of system. Replace unit if problem persists. Return to US&S for evaluation and repair.
	What if display appears frozen?	Unit might be waiting for completion of a programming session due to accidental actuation of the ESCAPE switch. Momentarily remove the unit from base to force re-initialization of system. Replace if problem persists and return malfunctioning unit to US&S for evaluation and repair.
Error Codes	What if unit functions normally but frequently displays an error code?	Unit should be replaced at the earliest opportunity. Return to US&S for evaluation and repair.
	What if unit display error code and appears to be locked-up, timing cycle will not run?	Note the error code. Momentarily remove the unit from base to force re-initialization of system. Replace unit if problem persists. Return to US&S for evaluation and repair.
Local Input	What if local energy is switched on/off simultaneously with control energy?	Pick-up delay will be consistently extended exactly two seconds longer than the set time interval due to system initialization delay when local is first powered-up.
	What if local energy is turned off while control energy remains on?	Timing cycle will be cutoff after approximately one second. A new timing cycle will commence immediately upon restoration of local energy and completion of the two second initialization delay.
	What if there is an interruption of local energy during programming session?	Previous time setting will be retained.
	What if local energy is coded at 75 or 240 ppm ?	The PN-150SST is intended to operate normally with the local input coded or steady. If coded, the code rate must be no less than 75 ppm with a 35% on-time.
	What if local energy drops below 9.2 volts?	Although the control voltage must be 9.2 volts or higher, the local voltage can be reduced below this value before operation is interrupted. A new timing cycle (or return to idle state) will begin once local energy is restored to at least 5-6 volts.

Topic	Question	Answer
Control Input	What if control energy is momentarily interrupted?	Interruptions less than 250 milliseconds will not disrupt operation. Longer interruptions will cause a new timing cycle to begin once energy is restored.
	What if the unit is removed from base during timing cycle? What if control and local energy are interrupted during timing cycle?	A new timing cycle will commence once unit is reinstalled and/or energy is applied to the local and control inputs. By design, the PN-150SST cannot short-time and there can be no residual effect caused by previous incomplete timing cycles.
	What if unit is subjected to repeated incomplete timing cycles due to circuit design? What if unit is subjected to frequent brief interruptions of control energy during timing cycle caused by poor shunting of track circuits?	Unlike electro-mechanical timers, no mechanical wear results from aborted timing cycles. Timer control circuits may often be simplified to take advantage of this characteristic.
	What if control energy drops below 9.2 volts.	Same as effect of interruption of control energy.

Section 5. Maintenance

No field or shop maintenance is required on the PN-150SST Solid State Timer. If the timer fails to operate properly, it is recommended that the relay be sent back to the US&S repair facility at 645 Russell Street, Batesburg, SC 29006.

Section 6. Technical Support

The Rapid Action Information Link Team (RAIL Team) is a group of experienced product and application engineers ready to assist you to resolve any technical issues concerning this product. Contact the RAIL Team at 1-800-652-7276 or by e-mail at railteam@switch.com.